BULLETIN

OF THE

TORREY BOTANICAL CLUB.

Vol. 21. Lancaster, Pa., July 20, 1894. No. 7.

The Comparative Anatomy of Corema alba and Corema Conradii.*

By Marion C. McEwen.

(Plate 210.)

The Order Empetraceæ includes but five species, all small evergreen plants with diœcious inconspicuous flowers and drupaceous fruit. They closely resemble one another and all have the general appearance of certain Ericaceæ. Of the genera now included in the Empetraceæ, Jussieu knew but one, and its resemblance to the Ericaceæ was so marked that he referred it to that order. Nuttall, on the contrary, in his description of the Empetraceæ, in 1818, considered them closely allied to the Coniferæ, while Don believed them to hold an intermediate position between Euphorbiaceæ and Celastraceæ. Dr. Gray, in the earlier editions of his Manual, placed the order between Euphorbiaceæ and Urticaceæ, while in the later editions it is put between Salicaceæ, with which it has little or no morphological connection and Ceratophyllaceæ.

In his description of the order, Dr. Gray indicates the questionable position of Empetraceæ by saying that it "has the foliage, aspect and compound pollen of heaths, the drupaceous fruit of *Arctostaphylos*, but the divided or laciniate stigmas, etc., of certain Euphorbiaceæ, and that it is "probably only an apetalous and polygamous or diœcious degenerate form of Ericaceæ."

* Investigation conducted at the Botanical Laboratory of Barnard College.

Within the family the question of generic relationship has been the subject of discussion. Their close resemblance in morphological characteristics evidently entitles the five species to be classed in the same natural order, but under how many or what genera is not so clear.

There are three genera now recognized in the order, namely, *Empetrum*, *Ceratiola* and *Corema*. In the genus *Empetrum* are two species, *nigrum* aud *rubrum*, the former being circumboreal and widely distributed in high altitudes, while the latter is found in Southern South America. There is one species of *Ceratiola*, *C. ericoides*, which is found in the southern United States.

The genus *Corema* was named by Don after a careful study of the then so-called third species of *Empetrum*, *E. album*. This plant, which was discovered in Portugal, and as yet has been found only there and in the Azores, was from its general appearance and habit at first referred to *Empetrum*. Later Don found morphological differences in the new species, notably in the number of cells of the ovary, the kind of inflorescence and the lack of any proper perianth, which he considered sufficient to constitute a new genus. This he called *Corema*, giving us the third genus of the Order Empetraceæ with the one species *C. alba*.

Until 1837 these four species, under three genera, were the only representatives of this order known, the genus *Corema* not being known to occur in this country.

About that date Dr. Conrad found near Pemberton Mills, New Jersey, a small evergreen plant which he failed to identify. Specimens coming into the posession of Dr. Torrey he referred it to the order Empetraceæ, placing it in the genus *Empetrum*, noting at the same time its agreement in some particulars with *C. alba*. Dr. Torrey named the new species, in honor of Dr. Conrad, *E. Conradii* (Ann. Lyc. N. Y., 4: 83. 1837).

A little later Tuckerman sent very complete specimens of the new species to Dr. Klotsch in Berlin, who decided that it did not properly belong to any of the three genera of Empetraceæ, but constituted a new genus of the same order. Accordingly, he published a detailed description of the new genus, calling it *Tuckermania*, in honor of Dr. Tuckerman (*T. Conradii* Klotsch, Wiegm. Arch. 7: 248. 1842). But as this generic name had already been

used by Nuttall, Tuckerman, in the same year, changed it to *Oakesia*, in honor of Dr. Oakes (*O. Conradii* Tuckerm., Hooker's Lond. Journ. Bot. 1842).

In the meantime Dr. Torrey and Dr. Gray had critically studied the plant in this country from fresh specimens, and they both became convinced that the new species agreed in all important characteristics with *Corema alba*, and accordingly in 1842 Dr. Torrey changed the name to *C. Conradii* (*C. Conradii* Torr.; Loud. Arb. Brit. 1092. 1842), and it has since remained under that genus.

We have, therefore, in the genus *Corema* two species; the one, *alba*, confined to Portugal and Azores; the other, *Conradii*, found only along the eastern coast of the United States, in widely separated localities, from Newfoundland to New Jersey.

Accepting the evolutionary idea of the origin of species, a puzzling question arises as to the genetic relationship between these two species, their geographical distribution being difficult to reconcile with the idea of a common origin.

The morphology of the two has already been carefully studied and described; their comparative anatomy, however, has not been considered. In view of the importance now given to anatomical characteristics in plant classification, the comparative anatomy of these two plants has been an interesting study, and it is the purpose of this paper to give some of the results of such a study.

It has been impossible with the material available to follow the development-history of the tissues from their origin in the embryo, and the anatomy of the root has not been attempted, but a comparative study of the tissues of the fully developed stem and leaf has revealed some points of resemblance and difference from which conclusions may be drawn as to relationship.

The thick, deeply-grooved, evergreen leaf of *C. alba*—the type of the genus—is about 1 mm. broad, and, including the short petiole, 7 mm. long. It somewhat resembles the small leaves of some Coniferæ. A cross-section of the mature leaf (Fig. III.), under the microscope, shows the morphology to be strikingly different from that indicated by the outward appearance. Instead of a solid mass of tissue, as it seems to the naked eye, we find a flat leaf with its blades rolled under and the edges turned in so that

only the upper surface of the leaf is visible from without, the lower surface lining the cavity thus formed. The groove on the under surface of the leaf is the narrow slit-like opening left between the rolled-under blades through which the lower surface of the leaf has direct communication with the air. The anatomy is in general that of the typical dicotyledonous leaf, but with some peculiarities to be described in detail.

Beginning with the upper epidermis (Fig. V.), the enormous size of its cells and the extreme thickness of the outer wall are first noticed. By actual measurement this outer epidermal wall, in some instances, equals one-fifth of the entire distance from the upper to the under surface of the leaf. The epidermal cells are further distinguished (Fig. V.) by a thickening of the walls which projects into and partially fills the lumen. These projections are sometimes in the form of irregular masses, but oftener the walls are thickened regularly, some time nearly filling the lumen. In all cases these thickenings, together with all the walls of the epidermal cells, except the sharply defined outer layer of the upper wall, respond to the tests for cellulose. The outer layer shows a cutin reaction. The mesophyll tissue consists of two layers of palisade cells and spongy tissue below of irregular branching parenchymatic cells with very large intercellular spaces. The lower epidermis, unlike the upper, consists of cells of ordinary size, and these are interrupted by numerous raised stomata. The entire lower surface of the leaf is thickly covered with hairs of two kinds—long, one-celled, thick-walled hairs, and three–five-celled capitate glands. The simple hairs predominate. The vascular system is simple, the shape of the leaf being such as to require but little supporting tissue. At regular intervals lateral bundles branch from the stout midrib, and there is a mere trace of bundles forming the net-veining of the dicotyledonous type. An entire absence of bast cells is a peculiarity of these bundles, a circumstance not remarkable in a leaf which needs so little strengthening element. An endodermis of somewhat thick-walled cells encloses the whole vascular system, separating the bundles from the surrounding tissues.

The leaf of *C. Conradii* is smaller and is minutely denticulate on the apparent margins, but otherwise it has the same outward

appearance as the *alba* leaf, that of a thickened evergreen leaf deeply grooved on the lower surface. A cross-section, however (Fig. IV.), shows its morphology to be very different from that of *alba*. The leaf of *alba* is flat, with its blades rolled in such a way as to simulate a thickened leaf; that of *Conradii* is really thickened. That is, the central portion of the leaf is thickened and the edges of the blade are abruptly turned under, their margins nearly meeting below the lower surface, forming a furrow and leaving a small triangular cavity along the lower surface. As in *alba*, only the upper surface of the leaf is visible from without, the lower surface lining the cavity.

Comparing now the anatomy (Fig. VI.) with that of *C. alba*, we find the cells of the upper epidermis unusually large and with the outer wall thickened, though usually not so much as in *alba*. These cells agree with the epidermal cells of *alba* in having the cellulose thickenings in the lumen. These growths occur in the remarkably large lumen of cells which have to sustain the weight of a heavily thickened cuticle. For this reason it would seem that their function is that of mechanical support, performing the same office that similar growths do in the lumen of some large tracheæ and other thin-walled cells which have to sustain the pressure of heavier tissues. In certain families, notably the Urticaceæ, there is often a deposit on the inner surface of the wall of the epidermal cells in the form of cystoliths. The growths found in the cells under discussion, however, show none of the chemical reactions of cystolith formations, but in both species seem to be pure cellulose. The mesophyll tissue is like that found in *alba*, its development corresponding to the morphology of the thickened *Conradii* leaf. The same simple vascular system occurs; the bundles have no bast element, and the whole is enclosed by the endodermis sheath.

Coming to the lower epidermis, with its accompanying stomata and hairs, some differences are seen, although there are the same epidermal cells of ordinary size, the distinctly raised stomata, and the two forms of hairs—the long, one-celled hairs and the three-five-celled capitate glands that are found in the *alba* leaf.

The first difference noticed is the position of the simple hairs. Instead of being mingled with the glands over the whole lower

surface of the leaf, they occur here only along the very edges of the incurved margins. These long hairs project from either margin in such a way as to interlace along the whole length of the groove on the lower surface of the leaf. There is also a great increase in the number of the raised stomata.

For the anatomy of the stem, sections were made in both species from shoots of one year's growth. Again, beginning with a description of *alba*, a cross-section shows, in general, the structure common to woody dicotyledonous stems of that age. Both species are alike in that there is no periderm formation the first year, but the epidermis remains until the formation of the second year's wood. This is somewhat unusual, because in stems where a periderm is formed it is likely to appear very early in the first season.

The epidermis, in the *alba* stem, consists of cells of ordinary size with the outer wall thickened and cutinized and the thickening extending into the radial walls. Next to the epidermis is the zone of cortical parenchyma, which varies in depth from two to several layers of large cells. Separating the cortical tissue from the central cylinder is a distinct layer of cells one layer in width. These cells have a longitudinal diameter about four times that of the radial and tangential, and their outer tangential walls are much thickened. Their walls also respond to the test for suberin, and they correspond to the endodermis sheath which DeBary describes as occurring in the stems of some woody dicotyledons. The phloem zone is narrow and, like the phloem of the leaf bundle, is peculiar in having no bast elements. The cambium zone is about two rows of cells in depth. The libriform cells have bordered pores in abundance on both their tangential and radial walls, but no simple pores. The ducts are numerous but not of unusual diameter for wood of this character, and they too have bordered pores and a few have spiral markings. Towards the pith are crowded the narrow tracheids which show both ring and spiral sculpturing. The medullary rays are one cell in width, and the pith cells are of the ordinary type.

Sections of the *Conradii* stem show a structure similar to that of *alba*. Its deviations from the typical dicotyledonous woody stem, like those of *C. alba*, are an endodermis sheath, an entire

absence of bast tissue, and the presence of only bordered pores in the libriform cells. This occurrence of only bordered pores in the libriform has been found by Dr. Gregory to be a characteristic common to the orders Empetraceæ and Ericaceæ—a fact which may bear upon the question of relationship between them.

This examination of the anatomy of the stem and leaf of the two species brings us to the question, What does it indicate regarding the relationship between *Corema Conradii* and *Corema alba?* Considering only the anatomy of the two stems, it leads decidedly to the opinion that they are species of the same genus. This relationship is not so strongly indicated, however, by the character of the leaves.

Taking *alba* as the type of the genus, the variations from the type shown in the *Conradii* leaf would indicate an adaptation of that plant to a changed environment rather than an original generic difference. This plant, *C. Conradii*, has apparently adapted itself to a climate subject to drought and extremes of heat and cold. This is first shown by the thickening of the leaf, whereby the working tissues are more compactly arranged and a smaller surface is exposed. To provide against long continued drought, there is an arrangement similar to that found on leaves which are known to need protection from excessive evaporation. The long hairs before referred to, which are found only on the very edges of the *Conradii* leaf, interlace, forming a felt-like mass, with only capillary spaces through which the lower surface of the leaf has communication with the air. This regulates the amount of evaporation from the stomata by retarding the escape of moisture from the channel inside, while at the same time, by retaining the heat given off, it protects it against the cold.

On the other hand, this arrangement of hairs, which prevents evaporation and raises the temperature of the leaf, hinders the free interchange of gases. This, again, is remedied by the raised stomata. If the stomata were sunken, or even level with the epidermis, it would be difficult to effect the proper circulation inside the tissues. Hence the development of the raised stomata, which, by their form, allow a freer passage of air in and out. Furthermore, there is a great increase in the number of stomata over those on the *alba* leaf.

The leaf of *C. alba*, though similar in many respects, does not show the same adaptation to extremes of climate. It is more nearly flat, thus exposing a larger surface. The rolling under of the blade and the growth of hairs on the lower surface form a protected cavity which, in a measure, regulates the amount of evaporation through the stomata, but still the air has free access to the whole surface. Here again are the raised stomata, but much fewer in number. In one respect, however, this leaf is better prepared for extremes of temperature, namely, the enormous thickness of the cutinized outer wall of the upper epidermis, which even exceeds that of *Conradii* in most instances.

The leaf is the first organ where we should expect to find changes for the accommodation of the plant to a changed environment. It is primarily the organ for the individual uses of the plant, for through it is obtained food material from the air, and in it the chief processes of metabolism are supposed to take place.

Again, it is the metamorphosed leaf which is used for the reproductive processes of the plant. Here the leaf gives up its function as the servant of the individual and its energy is turned to the perpetuation of the species. In the whole life history of a plant species the leaf is the inconstant organ, changing its form and function for the varying needs of the individual and the species. The stem, on the contrary, is the constant organ. It is, therefore, to the anatomy of the stem, rather than that of the leaf, that botanists attach the first importance in the determination of relationship. In the same genus only the slightest variations are expected in the anatomy of the stems of the different species.

In the two species under discussion the stem of *Conradii* agrees with that of *C. alba* in all particulars, showing the same deviations from the normal dicotyledonous type. The leaf of *Conradii* has all the peculiarties of *alba* shown in the raised stomata, the two sorts of hairs, the extremely thick cuticle, and the unusually large epidermal cells with the strengthening projections of the cellulose wall. It disagrees in ways which indicate adaptation to environment rather than difference in origin.

Therefore, the result of the comparative study of the tissues favors the classification already made of these two species.

In view of the resemblance between the orders, a comparison

of the anatomy of the species of Empetraceæ with the typical Ericaceæ would be an interesting study, and this we hope to accomplish.

Explanation of Plate 210.

FIG. I. Leaf of *C. alba*, lower surface. a. Groove.

FIG. II. Leaf of *C. Conradii*, lower surface. a. Groove.

FIG. III. Outline of cross-section of leaf of *C. alba*.

FIG. IV. Outline of cross-section of leaf of *C. Conradii*.

FIG. V. Portion of a cross-section of a mature leaf of *C. alba*. a. Thickened cuticle. b. Lumen of the large epidermal cells. c. Thickenings of the cellulose wall of epidermal cells. e. Raised stomata on lower surface. f. Simple hairs. g. Glands.

FIG. VI. Portion of cross-section of a mature leaf of *C. Conradii*. a. Thickened cuticle. b, b. Lumen of epidermal cells. c, c. Thickenings of cellulose wall of epidermal cells. d. Midrib. e. Raised stomata. f. Simple hairs. g. Capitate glands.

FIG. VII. Cross-section of stem of *C. alba* one year old. a. Epidermis. b. Rind parenchyma. c. Endodermis.

Some New and Rare Desmids of the United States.—I.

BY L. N. JOHNSON.

(PLATE 211.)

During the last two or three years the writer has examined quantities of material rich in Desmids from various parts of the country. Among the species noted are some rarities, while a few are apparently unrecorded from the United States, and several are undescribed. It is not my purpose here to give complete lists of all species found, but merely to mention some of the most interesting "finds." The Connecticut specimens mentioned, unless otherwise stated below, were collected at Bridgeport, those from New York at Cold Spring Harbor and the Michigan material at New Baltimore. Curiously enough in these gatherings some of the species recorded by Wolle as common have proved very rare, or have not been seen at all. For example, *Tetmemorus Brebissonii* (Menegh.) Ralfs. has been found but once, and then but a

single specimen at Waverly, Mass. On the other hand, some so-called rare species have proved rather abundant, at least in certain localities.

Of the filamentous forms the most interesting were *Onychonema filiforme* (Ehrenb.) Roy and Bissett, and *O. leve* Nordst. at Bridgeport, and *O. leve*, var. *micracanthum* Nordst. from Michigan. The spines of the last named were often not so large as shown in the drawing (Fig. 15). *Hyalotheca undulata* Nordst. was found (Conn.) having a diameter of about 7 μ and with the sheath inconspicuous if present. It thus resembles the type more closely than Wolle's description.

Sphærozosma pulchellum (Arch.) Rab. is frequent in Connecticut, as is another species, undoubtedly *S. Wallichii* Jacobsen. It agrees well with Wallich's description and figures* of *S. excavatum* var. β. It was very abundant last season in the locality mentioned, and across the Sound in New York, and was also found in Michigan. Dimensions, length 12–14 μ, diameter 10–12 μ.

Spirotænia obscura Ralfs. was found near Oyster Bay, N. Y., in 1893. The specimens were in fine condition, and averaged 25 μ in diameter, thus being of about the same size as European specimens. Wolle gives the diameter 8–15 μ.

Of *Closterium* the most noteworthy species collected are *Cl. lineatum* Ehrb. var. *costatum* Wolle (Conn.), *Cl. didymotocum* Corda (Conn.), and *Cl. malinvernianum* DeNot (Mich.). The second agrees perfectly with descriptions and figures of the species named, but the diameter of the cells is 45–52 μ Delponte figures it from Italy of similar form and size. The last may be *Cl. Ehrenbergii* Menegh. var. *brasiliense* Nordst., for there seems little difference between the two forms. The membrane is finely striate, diameter of cell 92 μ, and length eight times as great. It has not before been reported from the United States.

My specimens of *Euastrum gemmatum* Breb., do not resemble Wolle's figures very closely, but are much like those of Ralfs. It is common in Connecticut material.

Euastrum binale Ralfs. var. *insulare* Wittr., of the form shown in Fig. 8, is quite common in Michigan and Connecticut material.

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* Annals and Mag. of Nat. Hist., Ser. 3, 5: 192, *pl. VII., fig. 15* (1860).

E. pinnatum Ralfs, I have from Florida, Connecticut and New York.

At Cold Spring Harbor, N. Y., a number of species of *Micrasterias* were abundant last summer, the most noteworthy being *M. foliacea* Bail. (sometimes in filaments of a hundred cells), *M. papillifera* Breb., and *M. muricata* (Bailey) Ralfs. *M. furcata* Ag. was also common and extremely variable, as shown elsewhere.*

Of *Cosmarium* many interesting forms have been found. The following deserve mention:

C. anisochondrum Nordst. (Mich.).

C. Boeckii Wittr. (Conn.).

C. calcareum Wittr. (Mich.), Fig. 13. This agrees well with Wittrock's description and figures,† except that the larger granules, nine or ten in number, are often arranged in an ellipse with two partly fused ones in the center. Dimensions: length 18–20 μ; diameter 18 μ.

C. cyclicum Lund. (Ann Arbor, Mich.), Fig. 5.

C. impressulum Elfv. (Mich.), Fig. 6. This has probably been passed over as one of the forms of *C. Meneghinii* Breb. It is quite common.

C. monomazum Lund. var. *polymazum* Nordst. (Edgemoor, Ind.).

C. protractum Arch. (Evanston, Ill., and Waverly, Mass.).

C. Quasillus Lund. (Ann Arbor and Northfield, Mich.).

C. subglobosum Nordst. (N. Y.), Fig. 7. This agrees well with Nordstedt's figures and description,‡ except in the relatively short cells. The dimensions given in the original description were, length 37–48 μ, diameter 24–40 μ, while in these specimens they are, length 33–36 μ, diameter 26–28 μ.

C. subspeciosum Nordst. (Mich).

C. sulcatum Nordst. (Mich. and Conn.), Fig. 11. The specimens were quite abundant and were typical. Dimensions: length, 38 μ; diam., 30 μ; isth., 8 μ.

C. suprospeciosum Wolle (Ann Arbor. Mich).

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* Botanical Gazette, **19**: 56, *pl. 6* (Feb., 1894).

† Om Gotlands och Ölands Sötvattens-alger, 58, *pl. 4, fig. 13* (1872).

‡ De algis aquae dulcis et de characeis ex insulis Sandvicensibus a Sv. Berggren, 1875, reportatis, p. 14, *pl. 1, fig. 13* (1878).

C. tenue Arch. (common almost everywhere). Often found in quantity and usually with zygospores. I believe it is the form described and figured by Wolle as *C. bioculatum* Breb. It cannot be that species, for it has smooth zygospores (see Wolle's figure, Desmids of the U. S., Pl. XVIII., Fig. 22).

C. triplicatum Wolle (Conn. and Ann Arbor, Mich).

C. tessellatum (Delp.) Nordst. (Ann Arbor, Mich.), Fig. 17. This is one of the most interesting species found. Only a single specimen was found, but that was in fine condition and agreed exactly with Delponte's figures and measurements. This specimen measured 68 x 140 μ. It has not before been found here.

In addition to this species the following are new to the United States.

C. calcareum Wittr., *C. cyclicum* Lund., *C. subglobosum*, Nordst. *C. subspeciosum* Nordst., *C. sulcatum* Nordst. It is interesting to note that of the new species described by Nordstedt from the Sandwich Islands, three have now been found in this country. They are *C. anisochondrum*, *C. sulglobosum* and *C. sulcatum.*

Staurastrum aspinosum Wolle was found abundantly in Connecticut and New York. Other interesting species are:

St. megacanthum Lund. (Conn.). Quite rare.

St. cuspidatum Breb. (Conn.). Only occasionally seen.

St. Hystrix Ralfs. (N. Y.). Scarce.

St. incisum Wolle (Edgemoor, Ind., Conn., and Ann Arbor, Mich.). My determination of this was confirmed by Mr. Wolle. Specimens have several times been found with one semi-cell typical and the other exactly like *St. crenulatum* (Naeg.) Delp.

St. irregulare West (Conn., N. Y.). Fig. 10. I refer here a small species which I have had under observation for several years. Since the plate for this paper was prepared this species has been described by W. West in the Journal of the Royal Micr. Society for 1894. I have not yet seen the paper, but through the kindness of Prof. Nordstedt have received tracings of the figures. The American specimens average 18–20 μ in diameter (with the rays), and 20–25 μ in length; isthmus 6 μ.

St. leptocladum Nordst. (N. Y. and Ann Arbor, Mich.), Fig. 2. The specimens are not exactly like Nordstedt's figures.‖ The

‖ Desmidiae Brasiliae. Aftryk af vidensk. Medd. fra den Naturh. Forening i Kbhvn., p. 218, *Pl. 4, Fig. 57* (1869).

base of the semi-cells is shorter, and on the end there is a double row of large divided granules along each side. The differences do not seem great enough to justify separation as a species or even as a variety.

St. leptocladum Nordst. var. *cornutum* Wille (Conn.) Fig. 3. The semi-cells show a row of short downward-pointing spines around the base; otherwise the specimens are like the original figures.

St. Ophiura Lund. (N. Y. and Conn.). Frequent. Most of the specimens have but five or six rays, though a few show seven or eight.

St. quadrispinatum Turn. (Edgemoor, Ind.).

St. Ravenelii Wood (Northfield, Mich.). The specimens do not show such an irregularity of the spines as mentioned by Wolle.

Xanthidium cristatum Breb. and *X. fasciculatum* Ehrenb. have been frequently found, but by far the most common form is that shown in Fig. 1. It is probably a form of *X. antilopæum* (Breb.) Kutz, var. *Minneapoliense* Wolle, but the spine on the side of the cell arises invariably *below* the row of granules. Moreover, there is a fifth spine on each end of the cell, nearly between the lower pair. In rare cases this is short or lacking. Prof. Nordstedt has figured¶ a cell of *X. antilopæum* (Breb.) Kutz, var. *polymazum* Nordst, one semi-cell of which shows this extra spine as a short stub. As the species seems so variable, it is hardly advisable to give a special name to this form, which doubtless runs into the others.

Besides the above named Desmids several new species have been found, and descriptions of them are here given.

Cosmarium nudiceps n. sp., Fig. 12. Length of cell 1⅓ times its breadth. Sinus deep, nearly linear. Semi-cells almost semi-circular, with two granules, one above the other at the base, and often traces of one or more above. On the side of the semi-cell and within the margin, nine diverging rows of large granules, the middle, with the first and third on each side, of three; the second of four and the outer of two. In vertical view elliptic with a band through the center bare, and the granules on each side. Length, 48–50 μ; diameter, 36–40 μ; thickness, 25 μ; isthmus, 12–14 μ.

Type in Herb. Johnson, 214. New Baltimore, Mich.

¶ Bidrag till Kännedomen om sydligare Norges Desmidiéer, *pl. 1, fig. 20* (1873).

This seems nearest *C. trinodulum* Nordst. (De Alg. et Char. 1: *pl. 1, fig. 4*), but differs in its larger size and the different arrangement of the granules.

Cos. angulare n. sp., Fig. 14. Length and breadth nearly equal. Sinus deep, linear. Semi-cells unequally hexagonal, with all the angles but those at the apex thickened or even slightly papillate. Sides diverging slightly from the basal angles to near middle of semi-cell, then sloping strongly to the truncate ends. In vertical view narrowly elliptical, with two papillæ near the middle and a smaller one at each end. Viewed from the side circular with a papilla on each side. Length 30–32 μ; diameter 26–30 μ; thickness 12 μ; isthmus 8–10 μ. Type in Herb. Johnson, 280. New Baltimore, Mich.

Staurastrum gyrans n. sp., Fig. 4. Length one-half the breadth. Semi-cells subcuneate, top slightly convex; angles prolonged into slender, slightly incurved rays. Margins of rays serrate-dentate, apices bearing each three short spines. In vertical view 5-radiate; at the base of each ray, on the left side, a strong horizontal spine. Length 20–25 μ; diameter with rays 40–48 μ, without rays 12 μ. Type in Herb. Johnson, 239. Cold Spring Harbor, N. Y.

St. bicoronatum n. sp., Fig. 9. Breadth greater than length. Semi-cells subhexagonal, top somewhat rounded; angles prolonged, each into a ray with three or four serrations, and apex trifid. At base of each ray on the upper side a stout forked spine. Above and between these two smaller ones below the end of the semi-cell. In vertical view triangular, the angles prolonged into serrate rays; two forked spines projecting beyond the margin on each side, with six smaller ones within the margin, forming a circle around the center. Length 14–16 μ; diameter (including rays) 22–25 μ; isthmus 6 μ. Type in Herb. Johnson, 221. Bridgeport, Conn.

In form this is somewhat like *St. proboscideum* (Breb.) Arch. forma *Javanica* Nordst. (De Alg. et Char. 1: p. 11, *pl. 1, fig. 19*,) but it is much smaller, and the processes are not truncate, but strongly bifurcate.

St. elegantissimum n. sp., Fig. 16. Breadth much greater than length. Semi-cells nearly square. Constriction shallow. Base of semi-cell armed with a row of short spines, sometimes with traces of a second; angles prolonged into slender slightly incurved rays armed with three spines at apex. Rays armed above and on each side with a row of sharp spiny teeth, several nearest the base bifurcate. In vertical view 4-radiate; within the margin on each side a row of several incurved bifurcate teeth, the two rows on opposite sides of the ray uniting into a median one near the

middle of the ray. Length, 36–38 μ; diameter with rays, 68–72 μ; without, 16–18 μ; isthmus, 12 μ.

Type in Herb. Johnson, 276. Bridgeport, Conn.

A single specimen was found having five rays on one end of the semi-cell. All the others were typical.

BOTANICAL LABORATORY, UNIVERSITY OF MICHIGAN.

Explanation of Plate 211.

(Reduced one-fourth in photographing.)

a, front view of cell; b, vertical view; c, side view.

1. Xanthidium antilopasum (Breb.) Kutz., var. Minneapoliense Wolle, forma. ×560.
2. Staurastrum leptocladum Nordst. ×560.
3. " " var. cornutum Wille. ×560.
4. St. gyrans n. sp. ×770.
5. Cosmarium cyclicum Lund. ×560.
6. C. impressulum Elfv. ×770.
7. C. subglobosum Nordst. ×770.
8. Euastrum binale Ralfs. var. insulare Wittr. ×770.
9. St. bicoronatum n. sp. ×1150.
10. St. irregulare West. ×1150.
11. C. sulcatum Nordst. ×560.
12. C. nudiceps n. sp. ×560.
13. C. calcareum Wittr. ×770.
14. C. angulare n. sp. ×770.
15. Onychonema leve var. micracanthum Nordst. ×770.
16. St. elegantissimum n. sp. ×560.
17. C. tessellatum (Delp.) Nordst. ×560.

Recent Discoveries of Cycadean Trunks in the Potomac Formation of Maryland.

BY LESTER F. WARD.

Scarcely any fact is better known to palæontologists than that of the discovery by Philip T. Tyson, in 1859, of two large cycadean trunks and some other fragments in the iron ore region of Maryland. These were not described at the time, and were only briefly mentioned in his first report as State Agricultural Chemist, published in January, 1860 (p. 42), where he refers to

them as "A new genus of a Cycas, of large dimensions, which will be described on another occasion." In immediate connection with this he also mentions "silicified coniferous wood," and "lignites (coniferous)." These he says were found in the "Iron Ore Clays (No. 22 in the illustrations)," and in the accompanying map he indicates the position of the Iron Ore Clays. The exact locality at which these trunks were found is not stated in Tyson's report, but Professor Uhler in the Transactions of the Maryland Academy of Sciences for 1888 (1: 7–8) says that "one specimen came from the iron ore beds of Mr. J. D. Latchford, near Muirkirk, a second from the vicinity of Hyattsville, and a third from similar clays next the shore of the Patapsco river at the Spring Gardens, south of Baltimore." From information in his possession Professor Uhler has also informed me of the discovery of apparently another specimen near Beltsville, on the property of Mr. Emack; also of a small fragment on the property of Dr. J. D. Jenkins, near Muirkirk. Professor Uhler has also mentioned to me the occurrence of still another specimen in the vicinity of Baltimore, which he was at the time negotiating for, but had not yet secured. These facts seem to constitute all the information in the possession of the scientific world relative to the occurrence of cycadean trunks in the State of Maryland down to the year 1893.

The description promised by Tyson never appeared, but a photograph of one of these specimens was made by him and distributed to the leading geologists of this country and Europe, a copy of which has recently come into my possession. Sir William Dawson, to whom a photograph was sent, showed it to Mr. William Carruthers, who mentioned it in a postscript to his important memoir "On Fossil Cycadean Stems from the Secondary Rocks of Britain,"* and says: "It is obviously a species of *Bennettites*, with smaller leaf-scars than those in *B. Saxbyanus*."

In his Flora of the Potomac Formation,"† Prof. Wm. M. Fontaine describes four specimens, consisting of two trunks and two fragments. From what he says of the localities (pp. 188, 193), they are evidently the same that have already been mentioned, although the precise language used in describing these localities

* Trans. Linn. Soc. **26**: 708, 1870.

† Monographs of the U. S. Geol. Survey, **15**: 186–193, *pl. clxxiv.–clxxx.*, 1889.

is somewhat different from that given by Professor Uhler. Professor Fontaine, in his laudable desire to do the maximum honor to the original discoverer, created a new genus of these forms and called them *Tysonia Marylandica*. As it turns out he would have accomplished his object much better had he given Tyson's name to the species instead of to the genus, since the latter cannot stand, as these forms obviously belong to the genus Cycadeoidea of Buckland, which was indeed recognized by Professor Fontaine, when, in a paper to the American Journal of Science,* in 1879, he used the name "*Cycadoidea*" in referring to these very specimens. At the same time, by the laws of nomenclature now so rigidly enforced, the species cannot be changed, and the name of Tyson drops out entirely.

The object of the present paper is to record the recent discovery and collection by Mr. Arthur Bibbins, Curator of the Museum of the Woman's College, Baltimore, of no less than thirty-five additional specimens of cycadean trunks and parts of trunks from the same general region as that in which Tyson's specimens were obtained. This I regard as one of the most important events in the history of palæontology in America, as it brings together such a body of facts relative to the cycadean vegetation of the Lower Cretaceous in Maryland that it will now be possible to give something like a complete history of that type of plants.

The specimens are all good, many of them extraordinarily fine. Nearly half of them are so complete that they may correctly be called trunks, and show nearly or quite all that was ever present; although often much distorted by pressure, and more or less flattened either laterally or vertically. Many of the remaining fragments show fully half the trunk, and have the advantage of exposing, on the broken side, the inner parts, the medullary axis, woody zones, and sections through the cortical portions. In several cases the scars produced by the separation of the medullary axis from the outer parts are very distinctly shown, and in one specimen we have a true *Cycadomyelon*, to the side of which the exterior portion of the trunk is attached for some distance, thus demonstrating for the first time the true nature of *Cycadomyelon*. In a number of the specimens the "crow's nest" is dis-

* III., 17: 157.

tinctly seen, but in several cases there is in the center of this crow's nest a prominent boss, symmetrical in form and conical in shape, which appears to be the terminal bud, which was petrified entire after it had been developed at the apex of the trunk.

It is fitting for many reasons that this event be made known to the scientific public. It is not necessary, of course, to dwell upon its scientific importance, but not only should the great service which Mr. Bibbins and the Woman's College have rendered to palæobotany be publicly recognized, but the manner and method by which this result has been accomplished should be set forth as an example of what a correct method is capable of accomplishing, and as a hint to others who may be engaged in similar lines of research.

The collection is primarily the result of the policy of the Woman's College in seeking to supply its students with scientific material to work upon. The Woman's College is a young institution founded some six years ago, but it is one which is rapidly coming to the front and cannot fail to take a place among the first of its class in the country. Its president and founder, Dr. John F. Goucher, to whose efforts its success is so largely due, is a man who possesses all the qualifications for the position he holds. The standard which he has set up is that of the highest excellence, and visitors to that college have only to look around to see that nothing has been left undone to place it in the front rank of institutions for the higher education of women. Its scientific departments are strong, being largely officered by graduates of Johns Hopkins and other leading universities. A museum has been established in connection with the scientific instruction, and an effort is being made to equip it with everything necessary for the successful study of nature, and Dr. Goucher does not believe, as so many seem to do, that nothing has value in a museum which has not been brought from some remote region.

In appointing Mr. Bibbins curator of the college the right step has been taken to further these ends. A post-graduate of Johns Hopkins at the time of his appointment, Mr. Bibbins has been trained to the best scientific work. He is naturally endowed in a high degree with true scientific instincts as well as with practical judgment and good sense. It is these qualities which have

led him to adopt an entirely new method in searching for scientific material. Knowing the rarity of fossil cycadean trunks and their great value to science, he set himself the task of trying to secure some of these for the college museum. But, instead of undertaking a hopeless and aimless quest, as has been done by geologists and collectors in the past, he chose to avail himself of the knowledge of the inhabitants of the districts in which the cycads were believed to occur. Supported by the Woman's College, which furnished him the means of transportation and met the small expense of his work, including an occasional *pour boire* to some needy farmer or miner who possessed information of great value, and usually gave it freely, he proceeded to visit the houses of the native population, and placing himself on a level with their powers of understanding, he was able to interrogate a large number of persons in such a way that they could not fail to comprehend his meaning. Having secured one specimen, he carried it about in his wagon and showed it to all whom he met. His surprise was great to find that a large proportion of the inhabitants of the iron ore districts had at some time in their lives seen similar things and were able to recognize them. In some cases a person to whom he would show his specimen would reply at once that there was such a stone in his barnyard or near his house, and by a very little negotiation he was able easily to secure it. By far the greater number, in fact nearly all, of the specimens were thus found in the possession of the people. Many of them could remember having ploughed them out of their fields, or taken them from their ore pits; others there were that had lain so long around farm houses whose occupants had several times changed that it was impossible to trace them to their original source, but usually even in such cases there was a tradition lingering in the family with regard to the peculiar stones. The reason why they were so universally picked up and brought to the house or the workshop or the barnyard or laid up in some conspicuous place seems to be that their peculiarity was instantly recognized. A countryman knows every stone that he has seen about his place, and if there be one which differs markedly from all others, especially if it has a certain symmetry of form or shows unusual and regular markings, he at once distinguishes it, is impressed by its

appearance, and probably, at first at least, couples with the notion of its strangeness some vague idea of its possible utility or money value. He therefore invariably picks it up and sequestrates it in some way. After many years, finding that there is no demand for it, that no one knows any use to which it can be put, he eventually loses interest in it, and it is pushed aside, forgotten, and perhaps covered up in some obscure corner. So that in addition to the specimens that Mr. Bibbins actually obtained, there remain quite a number which are known to exist, but which for the present cannot be found.

Mr. Bibbins always frames his questions with skill, taking care not to ask leading ones, realizing that the desire to please is liable to color the answer and make it conform to what it is supposed he desires to have said. He therefore always takes pains to induce these people to tell what they know independently of any suggestion on his part.

As an illustration of the accuracy with which such persons often observe and remember facts, may be mentioned a case in which one of these traditional lost specimens was being inquired after from an octogenarian who remembered seeing it some forty years before, and when asked if the "holes" in the stone were "round" he replied, "No, they were sort o' three-cornered," a remark which rendered it certain that the object was really a cycad.

When, in January last, I learned that this collection was being made, I immediately commenced making inquiries in regard to it. I was much interested in the subject from two points of view: first, in the hope of settling the question of the exact geological position of these remains; and secondly, in the hope that an opportunity might be secured of studying this collection in connection with that of a similar one from the Black Hills of South Dakota, which had been obtained by the National Museum, and upon which I was then engaged. My efforts were met in a liberal spirit, both by President Goucher and Mr. Bibbins, and the general result has been that the entire collection has been loaned to the National Museum and placed in my hands to be described and illustrated in a memoir which is now in preparation on the Fossil Cycadean Trunks of North America, in which it is ex-

pected that nearly or quite every specimen known from any part of the United States will be included. Prof. F. H. Knowlton will be associated with me in the publication of this memoir, and to him will be entrusted the important subject of their internal structure.

With regard to the first of the two above-named objects which I had in view, I may mention that the Woman's College has afforded me the much-prized opportunity of spending a week in the field with Mr. Bibbins in visiting all the localities at which the trunks have been found. In most cases, as already remarked, they were found by Mr. Bibbins at different places from those in which they had been first discovered, but there was always some quite definite knowledge to be obtained as to the original localities. These were themselves, it is true, often little calculated to throw light on their geological position, the earliest history in many cases not going back of a time when they were seen in some field or by the roadside in the country. I may here say in anticipation of what will be said in the general report now in preparation for publication by the Geological Survey on the geology of the Potomac formation, that in the course of the last five or six years, during which time I have been more or less actively engaged in the study of that formation, I have been able with some success to subdivide it into no less than six somewhat distinct horizons, and it was therefore directly germane to my investigations that the horizon to which the cycads belong should be fixed with certainty. Tyson, as has been seen, reported that they were found in the iron ore clays, and it has been the general belief ever since that this was their position. I had observed that the large quantities of silicified wood and most of the lignites that occur in this formation come from a much lower horizon, viz., that of the Fredericksburg freestone, which in Maryland is never hardened into rock, but exists in the form of loose sand and gravel, as indeed it does to a large extent in Virginia. Having found silicified wood immediately associated with the cycadean trunks of the Black Hills, and having also learned that it occurs in the same beds in which Professor Cragin found a similar specimen in Southern Kansas, I had suspected the possibility that the same would prove to be the case in Maryland, a view which Pro-

fessor Fontaine had held for some time, but we had been unable to find any cycads in place. It is a significant fact that in the photographic view made by Tyson large pieces of petrified wood stand side by side with the cycadean trunk, and, as already stated, he says that this occurs in the same beds. Although it proved very difficult to locate those of Maryland, still, in consequence of the very large number that have been found, it was possible, by the ordinary application of geologic reasoning, to trace these with greater or less certainty to their original position. There is only one case in which the exact spot was pointed out to us at which a specimen had been seen firmly adhering to and projecting from an original exposure. This was circumstantially described to us by a man who was undoubtedly altogether worthy of belief, and who, moreover, could have had no object in coloring the facts. He placed his hand on the spot where he had seen the stone projecting for many years, and stated that it subsequently fell out and rolled down into the bottom of a deep gulch, where it lay for a number of years longer, being carried with each season's freshet further and further down the gulch. At last his curiosity led him to pick it up and take it to his house, where Mr. Bibbins obtained it. If this information is reliable, which there is no reason to doubt, this specimen, at least, originally occurred in the "paint stone," which I have ascertained to belong to the same horizon as that of all the silicified wood. There are several other cases in which the position of the specimens could scarcely have been different from that of this one under any of the ordinary processes by which they were carried to the places where they were found, and there is not a single case which negatives the possibility of a similar origin. I regard the conclusion as altogether reliable that all the fossil cycadean trunks of Maryland were primarily entombed in the sandy deposits underlying the iron ore clays.*

Taking these facts in connection with the general flora of that horizon, so abundantly developed in certain parts of Virginia, we are in position to form a somewhat correct idea of the nature of the vegetation that then occupied the region along that important

* This refers to the so-called "brown ore" only. The "white ore" is found in the dark, carbonaceous clays below the paint stone.

line upon which the cities of New York, Philadelphia, Wilmington, Baltimore, Washington, Fredericksburg, Richmond, Petersburg and Weldon—or from the Hudson to the Roanoke—are situated to-day. Leaving out of account the abundant herbaceous vegetation which carpeted the ground and filled the swamps and marshes, the general picture arises in the mind of a great Sequoian forest, furnishing the silicified wood, in the midst of which, corresponding to the shrubby undergrowth of modern forests, were everywhere to be seen these short cycadean forms from six inches to two feet in diameter and rising from a few inches to several feet above ground, crowned at their summits by tufts of large palm-like or fern-like leaves, of striking aspect and great beauty.

There is quite a remarkable parallelism between the history of the discovery of these cycadean forms in Maryland with that which has recently been so graphically characterized by Senator Capellini in a monograph published jointly by him and Count Solms-Laubach on the Cycadean Trunks of the Italian Museums.*

The historical part of this memoir, written by Senator Capellini, has all the interest of a romance, and he enters into a minute description of the mode of occurrence, the original discovery, and the final disposition of the large number of objects of this class which have been found in Italy and have made their way to the several museums of that country. The literature itself dates back to 1745, while many of the specimens have been known for a much longer period. And some of these, though recently discovered, were found, like those of Maryland, in places where they had been placed at a very early date. One of them was found in a wall of great antiquity in the city of Verona, and another was taken from the top of a tomb in the ancient Etruscan Necropolis of Marzabotto, where it had been placed by the remote ancestors of the modern Italian race, either as an ornament, or in commemoration of some symbolic rite. Thus does the history of science repeat itself, and the new chapter, which has just been opened, is not the least interesting one of that history.

*I tronchi di Bennettitee dei musei Italiani. Notizie storiche, geologiche, botaniche, dei Professori Senatore G. Capellini e Conte E. Solms-Laubach. Mem. Real. Accad. Sci. Ist. Bologna (V.), 161–215, *pl. 1–5*.

Studies in the Botany of the Southeastern United States.—II.

By John K. Small.

(Plate 212.)

Isoetes melanospora Engelm. Trans. St. Louis Acad. Sci. 3: 395 (1877).

Up to the present time this *Isoetes* has not been known to occur at any but its original locality, Stone Mountain, Georgia, where Mr. Canby discovered it in 1869. During the past season I found it growing on Little Stone Mountain, Georgia, in shallow pools in the granite rocks, just as it occurs at the original station.

Xyris neglecta n. sp.

Annual, mostly strict, slender. Root fibrous; scapes usually two to four, sometimes one, 1–4 dm. long, ribbed with ten ridges, eight of which are arranged in pairs, two on either side of a line connecting the two most prominent ones, spirally twisted and sometimes slightly flexuous when old; sheath of the scape 4–6 cm. long, more or less reddish at the base; leaves linear, 3–10 cm. long, .3–.5 cm. broad, acute, straight or slightly curved, rather erect, 4–7-ribbed; flowers bright yellow, 3 mm. broad; petals irregularly erose; fruiting spike ovoid, 4–9 mm. long, acute; the scales orbicular-obovate, 3–5 mm. long, entire at the apex, imbricated in 6–7 rows; lateral sepal 4 mm. long, fimbriate-winged for ¼–⅓ of its length from the summit; seeds oblong, pointed at both ends, irregular in outline, furnished with tails equal to or longer than themselves.

Found by Mr. A. H. Curtiss growing in moist pine woods about Jacksonville, Florida, on August 11 and October 30, 1893, in company with *Xyris ambigua*, to which species it is related, but easily separated by its smaller size, shorter leaves and more slender spikes so far as the outside characters are concerned. The lateral sepal is also very differently crested and the seeds are smaller, narrower and more pointed. One of its strongest characters is the peculiarly ridged scape as described in the above diagnosis. The scape of *X. ambigua* is oblong in cross section and strongly two-ridged.

SMILAX ROTUNDIFOLIA CRENULATA Small & Heller, Mem. Torr. Club, 3: 17 (1892).

Grows in similar localities at Tallulah Falls, Georgia, especially at the bottom of the deep cañon, as in the forests on Grandfather Mountain, North Carolina, the original station.* The plants are almost identical with the type and exhibit well the principal characters. The lanceolate leaves and the erose-crenulate margins are particularly striking. We now have this form from Southwestern Virginia, North Carolina and Northern Georgia, and may expect to find it at intermediate places along the mountains.

CELTIS RETICULATA Torr. Ann. Lyc. N. Y. 2: 247 (1825).

There exists in the valley of the Yellow River, about eighteen miles east of Atlanta, Georgia, a slender *Celtis* with remarkably small leaves and of a diffusely branched habit. In some respects it differs from any form yet described, but is nearest to *C. reticulata* Torrey, a species of the Southern Rocky Mountain region.

The specimens are so similar to that species that I consider it better to place it there than to describe it as new. This form agrees very well with Dr. Torrey's type, differing principally in the smaller and acute or acuminate leaves, which do not vary much from an inch in length. Those of the type specimens are mostly obtuse and some an inch and a half long. However, we have specimens almost identical with mine from Santa Cruz Valley near Tuscon, Arizona (Pringle), and cañons in the Burro Mountains, New Mexico (Rusby). The leaf form of the plant under consideration corresponds almost exactly with those collections.

At first I thought this form might be *C. pumila*, but an authentic specimen of Pursh's plant in the Columbia College Herbarium shows that it is a form of *C. occidentalis*.

PRUNUS NIGRA Ait. Hort. Kew. 2: 165 (1789).

In the Silva of North America, Prof. Sargent has reëstablished and given us a clear conception of this good species. I have recently (August 11, 1893) discovered a grove of this plum in the foothills of the Blue Ridge between Tallulah Falls and Toccoa

* Mem. Torr. Club, 3: 17.

Falls, in Northern Georgia. The foliage, fruit, stone, etc., of my specimens are similar to those figured by Prof. Sargent in his Silva. The range given for the species extends only as far south as the valley of the St. Lawrence; however, the tree is probably more widely distributed than we are aware of, and we would naturally expect to find it in and about the Appalachian Mountain System.

The species is easily separated from *P. Americana* by its larger leaves, the larger and oblong fruit, and the strongly crested stone. The leaves of *P. Americana* are rather small, the fruit globose and the stone without a crest.

TRIFOLIUM SAXICOLUM n. sp.

Perennial by a strong root and numerous stolons, stout, glabrous, much branched from a woody base, procumbent, sometimes slightly ascending. Branches more or less creeping, the older portions becoming woody and covered with dry, membranous, chaffy stipules; internodes short, 3–17 mm. long, increasing in length towards the ends of the branches; leaves palmately-trifoliolate, numerous, rigid; stipules 6–8 mm. long, lanceolate, very acuminate, partly sheathing the branches; petiole .5–2.5 cm. long; leaflets obovate or obcordate, 3–8 mm. long, short-stalked, sometimes emarginate, with very sharp spine or prickle-like teeth except near the base, teeth sometimes double; secondary nerves straight and parallel, sometimes forking near the margin; peduncles five-angled, 2–6 cm. long; heads 40–70 flowered, rather dense; flowers white, drooping on deflexed pedicels in fruit; calyx narrowly-campanulate, 3 mm. long, cleft to the middle into fine subulate teeth, upper teeth shorter than the lower ones; corolla twice or thrice as long as the calyx when mature; vexillum undulate on the borders, erose at the apex; legume 2 mm. long, one to three-seeded, style persistent; seeds 1 mm. long, orbicular, ovoid, smooth, orange colored or reddish.

Found at the southern base of Stone Mountain, Georgia, growing in the loose piles of granite, altitude 1,100 feet. Not observed elsewhere in the mountain or vicinity. (Plate 212.)

The species is related to *T. Carolinianum*, but is separated from that and all our other species by its strong characters mentioned above.

TRIFOLIUM HYBRIDUM L. Sp. Pl. 766 (1753).

Although extensively naturalized and thoroughly established in the Northern States, this species has been slow in securing a

hold in the South. So far as I can learn it has not been observed south of Virginia, except about the village of Stone Mountain, Georgia, when I found it well established last July.

CRACCA INTERMEDIA n. sp.

Perennial by a woody base, pubescent throughout and slightly viscid about the nodes. Stems 4–6 dm. long, branched from the base and throughout, spreading, assurgent, flexuous and more or less angled; leaves oblong-obovate in outline, 6–12 cm. long, 3.5–6 cm. broad; petioles 1–2 cm. long, rachis four-angled; leaflets 7–11, oblong-obovate, 1–3 cm. long, .7–1.7 cm. broad, strigose on the lower surface, glabrous on the upper surface, truncate or slightly emarginate at the apex, more or less apiculate by the excurrent midrib, very short petioluled; peduncles as long as the leaves, four-angled; pedicels 6–8 mm. long; flowers dark red, 1.3–1.7 cm. long; calyx teeth lanceolate, acuminate; legume 3.5–4 cm. long, either solitary or two arising from the same place; seeds five to nine, oblong or oblong-ovoid, compressed, smooth and variegated.

Intermediate between *Cracca ambigua* and *C. chrysophylla*, but of the two, more closely related to the latter, from which, however, it differs in its assurgent habit, the greater number and the shape of the leaflets, the smaller flowers and larger seeds. The habit of *C. chrysophylla* is strictly prostrate, the leaflets are 5–9 in number, and obovate-cuneate in outline. The seed is only one-half as large, dull and slightly roughened, and obliquely-obovoid in shape. *C. intermedia* also lacks the silky pubescence of *C. chrysophylla*.

The species grows in dry and poor "blackjack thickets" about Jacksonville, Florida, and was found by Mr. A. H. Curtiss in 1893, flowering on May 31st and in mature fruit on July 11th.

HIBISCUS SYRIACUS L. Sp. Pl. 695 (1753).

Is thoroughly established about Stone Mountain, Georgia.

PHACELIA DUBIA (L).

Polemonium dubium L. Sp. Pl. 163 (1753).

Phacelia parviflora Pursh, Fl. Am. Sept. 140 (1814).

PHACELIA HIRSUTA Nutt. Trans. Amer. Phil. Soc. (II.) **5**: 191 (1833–37).

Phacelia parviflora var. *hirsuta* A. Gray, Proc. Amer. Acad. **10**: 320 (1875).

Last year I had an opportunity to study this plant in the field in both the flowering and fruiting state, and have been lead to the conclusion that Nuttall was right in considering it a species. In April I encountered the plant in flower on Stone Mountain, Georgia, where it grows at altitudes ranging from 1,000–1,400 feet, and in July in fruit. Being well acquainted with *P. dubia* the dissimilarity between the two forms was striking and in the living state *P. hirsuta* does not exhibit much likeness to *P. dubia*.

The plant is of a shorter and stouter build, erect and of a firm texture, and the racemes crowded even in fruit, whereas *P. dubia* is elongated, slender, spreading and with early interrupted racemes. The flowers and fruit furnish good distinctive characters: The corolla of *P. hirsuta* ranges from 13–15 mm. in breadth and the segments strictly entire, while that of *P. dubia* is only 8–11 mm. broad and has the segments more or less erose. The color of the former is dark purple, or, according to Nuttall, "purplish blue," and its pod is less compressed than the latter; the seeds are twice as large, covered with large papillæ. The pod of *P. hirsuta* is orbicular, rather broader than high, opposed to the broadly oblong pod of *P. dubia*.

PENTSTEMON SMALLII Heller, Bull. Torr. Club, **21**: 25 (1894).

Mr. E. P. Bicknell has lately discovered this handsome species at Nashville, Tennessee. He remarks that it grows plentifully on the bluffs of the Cumberland River about that city. Two forms were noticed and collected by Mr. Bicknell; the one has glabrous leaves as in the type, while in the other both the upper and lower surfaces of the leaves are canescent. I never noticed this latter character on any of the numerous plants observed and collected by Mr. Heller and myself in the mountains of North Carolina. It is probably due to local influences. The plants were in full bloom during the first weeks of May. The above collection extends the geographical range of this *Pentstemon* about two hundred miles to the west, Knoxville being previously the western known limit.

CUSCUTA ARVENSIS Beyrich; Hook. Fl. Bor. Am. **2**: 77 (1834).

Grows about the base of Stone Mountain, Georgia, in mats on *Gymnolomia Porteri*, where this species forms dense patches. There

its color is not "pale," but a rather dark yellow. The young corolla, scales, etc., correspond to Mr. Matthew's figures;* but one corolla-segment is always narrower than the other four, sometimes only one-half as broad. This is probably a transition to a four-cleft state of the perianth which exists in some species. The filaments on the persistent corollas develop so as to appear as small segments, carrying out the fringed scale with them.

LONICERA FLAVA Sims, Bot. Mag. *t. 1318* (1810).

Heretofore only two localities for this rare and showy *Lonicera* have been known. According to Sims,† *Lonicera flava* was discovered by Mr. Fraser and his son on the exposed and rocky summit of Paris Mountain, South Carolina, noting that they failed to find it elsewhere. In 1836 Dr. Boykin found the species in the "upper districts of Georgia," but unfortunately failed to give any definite station. In April, 1891, Mrs. J. G. Smith rediscovered it at the original locality.

About the middle of April, 1893, I encountered the plant in full bloom on the summit of Little Stone Mountain, Georgia. This mountain is situated south of Stone Mountain, distant about nine miles. It is a flat, granite dome, rising about one hundred and fifty feet above the surrounding plain; the slopes are nearly bare, consisting of flat, granite pavements, but a small area of the top is capped by a layer of sandy soil several feet thick. This is covered by a rather dense growth of shrubs and trees, except the highest point, which is several square yards in extent. Here three plants of *Lonicera flava* grow, spreading over the undershrubs and the ground. The stems are covered with a loose, fibrous bark, and root freely at the nodes where they lie on the ground. It is a most handsome plant when in flower, the corolla being of a bright, golden color. On a second visit to that region in July the abundant fruit was just about maturing. During a month's exploration of the vicinty no other station was observed until my last trip on Stone Mountain, where I came upon several plants growing in the woods on the northern cliffs of the mountain.

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* Bull. Torr. Club, 20: *pl. 164.*

† Bot. Mag. *t. 1318.*

The species is evidently locally distributed, but will doubtless be found at new stations as the States of Georgia and South Carolina are better explored.

VIBURNUM FERRUGINEUM (T. & G.) Small, Mem. Torr. Club, 4: 123 (1894).

Mr. Bicknell recently brought me specimens of a *Viburnum*, from Nashville, Tennessee, saying that it was very different from anything he has previously observed and that no allowance was made for it in our manuals. It is typical *V. ferrugineum*, whose excellent characters I have pointed out in another place.* At Nashville it grows in the rocky banks of the Cumberland River in localities similar to the one on the Pinnacle at Cumberland Gap, where I rediscovered the species two years ago. Last season I also found many fine trees of this species in the bottom of a rocky cañon along the Yellow River, in Middle Georgia. The specimens from the latter locality, as well as Mr. Bicknell's, are identical with those from Cumberland Gap, in the Cumberland Mountains. The discoveries at Nashville and in Georgia do not increase the geographical range, but serve to show that the species is probably not scarce in the Southern States, but has simply been unobserved. All our Eastern specimens are very constant as to characters and habitat, the greatest variation being in the specimens from the Southwest. In these the leaves are smaller, more coriaceous and the tomentum on the petiole is more abundant.

VIBURNUM CASSINOIDES L. Sp. Pl. Ed. 2, 384 (1763).

This species was first found in the Southern States during the summer of 1891,† throughout the mountains of Western North Carolina. During the last season I encountered it first at Tallulah Falls, where it grows in the bottom of the deep cañon, and later along brooks throughout the mountains between the Tallulah River and the source of the Tennessee River, in Northern Georgia. It is the prevailing *Viburnum* in that region.

ERIGERON RAMOSUS BEYRICHII (Fisch. & Meyer).

Stenactis Beyrichii Fisch. & Meyer, Ind. Sem. Petrop. 5: 27 (1838).

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* Mem. Torr. Club, 4: 123.

† Mem. Torr. Club, 3: 6 and 27.

Erigeron strigosus var. *Beyrichii*, T. & G. Fl. N. A. 2: 175 (1843).

This rare and distinct form has lately been collected by Dr. Mohr in Alabama, growing on calcareous hills near Russellville. The plant was first found by Beyrich in "Carolina," and later discoveries show it to range from "Carolina" to Florida, St. Marks (Rugel) to Indian Territory, on the False Washita (Palmer, 479).

COREOPSIS INTEGRIFOLIA Poir. in Lam. Encycl. Suppl. 2: 353 (1811).

Fine specimens of a *Coreopsis*, which apparently belong to the above species, have been secured by Mr. A. H. Curtiss from the region between Jacksonville and Trout Creek, Florida. Authentic material of *C. integrifolia* is meagre, but I have carefully compared the Florida plants with it and find the two almost identical. The flowers, rays and styles are alike, and the leaves agree very well in shape, but those found by Mr. Curtiss have somewhat longer petioles. The plants grow on borders of wet thickets and were in flower and fruit on October 21, 1893.

A New Fossil Nelumbo from the Laramie Group at Florence, Colo.

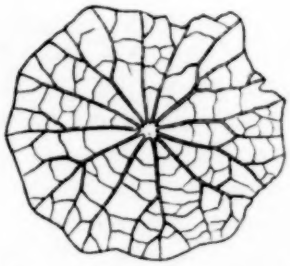
BY ARTHUR HOLLICK.

NELUMBO LARAMIENSIS n. sp.

Leaf orbicular, about 1½′ in diameter, with wavy margin, centrally peltate; primary nerves strong, diverging somewhat irregularly from the centre, forked 1–several times, connected by cross-nervation which is slightly angled or bent outward, especially near the margin.

This little leaf was found in a collection of fossil plants made by Mr. George Hadden from the Laramie group at Florence, Colorado, for the late Dr. J. S. Newberry. Its affinities with the genus *Nelumbo* can hardly be questioned, and it is clearly different from every other fossil species thus far described from this country. In regard to the foreign species I can not be so certain, as some of these have been described or merely named but not figured, and

it is very doubtful if they all belong in the genus.* Schimper, in his Traité de Paléontologie Végétale, **3**: 95, says in regard to *N. Casparianum* Heer and *N. nymphæoidea* Ettingsh.: "I do not think that the true position of these two last fossils is in the genus *Nelumbium*," but further than this I would not wish to carry the criticism without having had an opportunity to examine the material upon which the names were based. It is, however, pertinent perhaps in this place to call attention to the leaf which was



NELUMBO LARAMIENSIS HOLLICK.

described by Sir J. W. Dawson (*Brasenia antiqua* Dawson, Trans. Roy. Soc. Canada, **3, Sec. 4**: 15 (1885)) from the Belly River beds of British Columbia, representing a geological horizon practically equivalent to our Laramie. From the description and figure as given by Dawson it appears to resemble *Nelumbo* more closely

* The geological range of the genus is from the middle cretaceous to the miocene tertiary, and of the thirteen previously named species, five are American, seven are European, and one is Asiatic. For the completeness of the following references I am indebted to Prof. Lester F. Ward, of the United States Geological Survey.

AMERICAN.

1. *N. tenuifolium* Lesq. in Hayden's Ann. Rept. U. S. Geol. and Geog. Surv. 1873, 402; Lesq. Tert. Fl. 253, *pl. 46, fig. 3.*
2. *N Lakesianum* Lesq. in Hayden's Ann. Rept. U. S. Geol. and Geog. Surv. 1873, 403; = *N. Lakesii* Lesq. Tert. Fl. 252, *pl. 46, figs. 1, 2.*
3. *N. arcticum* Heer, Fl. Foss. Arct. **6, Abth. 2**: 92, *pl. 40, fig. 6.*
4. *N. Saskatchuense* Daws. Trans. Roy. Soc. Canada, **5, Sec. 4**: 35.
5. *N. pygmæum* Daws. Trans. Roy. Soc. Canada, **8, Sec. 4**: 87, *fig. 22.*

EUROPEAN.

6. *N. Buchii* Ettingsh. Sitzb. Wien Akad. **10**: 428; Denkschr. Wien Akad. **8**: 36, *pl. 10, figs. 2, 3; 11, fig. 1; 12.*

than it does *Brasenia*. Further than this, the name *Brasenia antiqua* was preoccupied at the time of its adoption by Dawson, a fact in regard to which he was apparently in ignorance (see *Brasenia antiqua* Newberry, desc. in Proc. U. S. Nat. Mus. **5**: 514 (1882); undistributed plates, Cret. and Tert. Floras, *pl. 68, fig. 7*) and as Newberry's specimen, consisting of stems and fruit only, is from the eocene tertiary, there is little likelihood that the two are referable to the same species.

Under the circumstances I would propose that Dawson's plant be renamed, in accordance with recently adopted rules of nomenclature, as follows: *Nelumbo Dawsoni* = *Brasenia antiqua* Dawson (1885), not *Brasenia antiqua* Newberry (1882).

By this means Dawson's name may still be retained in connection with the plant which he unwittingly described under a name already preoccupied.

Finally, it may perhaps not be amiss to call attention to the geographical distribution of the living species. Only two are recognized, viz.: *N. nucifera* Gaertn., ranging from the Caspian Sea to Japan and thence southward to Australia, and *N. lutea* (Willd.) Pers., ranging from Kansas and Missouri to Lake Erie and thence southward to the West Indies. It is another example of the similarity between the floras of Eastern Asia and Eastern North America which has so often attracted the attention of those who

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7. *N. nymphæoidea* Ettingsh. Sitzb. Wien Akad. **12**: 182; Denkschr. Wien Akad. **8**: 37, *pl. 10, fig. 1; 11, fig. 2.* = *N. nymphæoides* Ettingsh. (Schimp. Paléont. Veg. **3**: 95).

8. *N. Casparianum* Heer, Fl. Tert. Helvet. **3**: 299. = *N. Casparyanum* Heer (Schimp. Paléont. Veg. **3**: 95).

9. *N. microcarpum* Ettingsh. and Gard. Proc. Roy. Soc. London, **29**: 395.

10. *N. Ettingshauseni* Sieber, Sitzb. Wien Akad. **82, Abh. 1**: 83, *pl. 2, figs. 15, 16.*

11. *N. provinciale* Sap. in Saporta and Marion's L' Évolution du Règne Végétale, Phanerogames, **2**: 125, *fig. 128;* Mém. Soc. Géol. de France, **1, Fasc. 3**: 2, 5, 7, *pl. 1, fig. 1; 2, fig. 1; 3, figs. 1–6a.* (*N. gallo-provinciale* Sap. in Zittel's Handbuch der Palæontologie, 509, is a mistake for *N. provinciale* Sap., made in describing the leaf of *N. provinciale* figured by Saporta as above, in connection with a valve of *Unio gallo-provinciale.*)

12. *N. proto-speciosum* Sap. Rev. Gen. de Bot. **2**: 192; Mém. Soc. Géol. de France, **2, Fasc. 1**: 5, 17, *pl. 1, figs. 2, 3; 4, figs. 1, 2.*

ASIATIC.

13. *Nelumbium* sp. Nath. Pal. Abhandl. **4**: 27, *pl. 7, fig. 20.*

are interested in the problem of the distribution of plants. In this connection the fact that the genus was of almost universal distribution in the past, at least over the whole Northern hemisphere, until comparatively recent geologic times, is of the greatest interest and significance, not only in regard to its present distribution, but also in regard to the evolution of the living species. We are no longer under the necessity of accepting the almost impossible theory that the plants have migrated in modern times from one continent to another, but are irresistibly led to the rational conclusion that, inasmuch as the genus existed on both continents until very recent geologic times, the presence of the living species in their now isolated and widely separated ranges is merely due to the extinction of plants from former intermediate localities, probably due to the vast climatic changes wrought by the advent of the Ice Age. We should also be within the bounds of reason if we supposed that the two living species may have been merged in one common ancestor at no very remote date, and that the specific differences which we now note as existing between them have resulted from differences in environment since their isolation from each other.

We may also note, as of interest, that the leaves have constantly increased in size up to the present time. The American cretaceous species, if we except *N. arctica* Heer, from Greenland, began with leaves little more than an inch in diameter. In tertiary times they had developed to a diameter of four or five inches, while at the present day they reach a size of two feet or more.

Varieties of Solidago and Aster.

SOLIDAGO CANADENSIS GLABRATA n. var.

Stems low, 2–3 ft. high, puberulent above; leaves numerous, linear-lanceolate, upper ones entire, lower ones with a few sharp serratures, smooth above, somewhat pubescent on the midrib and veins beneath; panicles small, with slender branches; heads small; bracts of the involucre acute or acutish; rays short and few.

Mt. Desert Island, Me., *Rand* and *Redfield*. At several points along the Susquehanna river, Pa. In some states it approaches *S. rupestris* Raf.

SOLIDAGO PURSHII (*S. humilis* Pursh).

The name *humilis* of Miller's Dict., n. 16, antedates that of Pursh and was given to a low form of *S. Canadensis*, included perhaps in the variety just described.

ASTER NEMORALIS BLAKEI n. var.

Stems 1–2½ ft. high; leaves not crowded, 2½–3 inches long, ½–¾ of an inch wide, lanceolate, coarsely toothed or entire, margins not revolute; heads few or sometimes solitary; rays lilac-purple.

Gilmanton, N. H., *Blake*, 1864; Mt. Desert Island, Me., *Rand*, 1893.

Intermediate between the species and *A. acuminatus*. The type is confined chiefly to the bogs of the sea coast, whilst the variety extends inland, and is found even high up on the mountains. The specimens received from Mr. Rand are nearer to *A. acuminatus* than others that have been examined.

THOS. C. PORTER.

Botanical Notes.

Peculiar "Range" in an autœcious Uromyces. It goes without saying that parasitic fungi prefer certain portions of plants. Some confine themselves to the stem, others to the root, while a large number are limited in their growth to the foliage. The smuts, while wide feeders, usually produce their spores in the malformed ovary, and the ergots in a similar manner flourish in the inflorescence.

Attention is here called to the position occupied by the fruiting of two forms of a species of a rust, namely: *Uromyces Caladii*, which is very common upon *Peltandra Virginica*, and *Arisæma triphyllum*. In the former host the æcidia are confined almost exclusively to the petiole and midrib of the leaf with occasional cups along some of the secondary veins. The teleutospores, appearing later in the season, seem to prefer the blade of the leaf, but may be met with upon the petiole and midrib. In this case the greater limitation is on the side of the earlier stage of the parasite, namely, the æcidial form.

Passing now to the *Arisæma*, there is an additional point of interest in that æcidia, as before, are more limited in their range. While not producing cups upon the petiole and midrib exclusively, it is true that a margin of the leaf that lies outside of a boundary line made by the blending of sub-peripheral veins does not as a rule bear the æcidia. On the other hand, the teleutospores have a preference for this outer belt of the leaf, and frequently are not found elsewhere.

The two companion leaves in the engraving, the one of the æcidial and the second of the teleutospore form of the fungus,

illustrate the point, the leaves being chosen from a few chance specimens in the herbarium. It is most likely that with a little search for them in the field much more striking examples could be found of this peculiarity in the leaf range of this polymorphic parasite.

The fact that the æcidia are most abundant upon the petiole and main vein of the *Peltandra*, and not infrequently appear upon the stem and inflorescence of *Arisæma*, would indicate that the greater thickness or greater succulence, or both combined, furnish in more favorable conditions for the development of the æcidia. In fact this, the first form of the fungus, develops its cups often be-

fore the leaf has expanded, and this element of time may be a third reason for the limitation noted. On the other hand, the outer portion of the leaf may furnish for similar reasons later in the season a better feeding ground for the subsequent forms of the rust fuugus.

BYRON D. HALSTED.

RUTGERS COLLEGE, March 20, 1894.

Sherardia arvensis in New Jersey. A plant of *Sherardia arvensis* was found by Mrs. Wm. Z. Flitcraft, of Woodstown, N. J., Vice-President of the Naturalists' Field Club of that place, on May 10, 1894, in the Library Hall lot in Woodstown, owned by Mr. Flitcraft. The lot around the building has been in grass for many years, with the exception of a border around it planted in rose bushes. The plant was found in the grass plot just inside of this border. The one specimen is all that was found, and was pulled up by Mrs. Flitcraft by the root, so as to better determine its character, as the plant was altogether new to her. Miss Cornelia Woolman, a member of the Field Club, pronounced it *Sherardia arvensis*, which was confirmed by myself, and also by Prof. N. L. Britton. How it came in the lot is unknown. It may have come from seed deposited with manure or grass seed sown on some bare patches of the lawn within the past two years. It is possible that there are other roots near the place it was found, and the plot will not be mowed again for some time, so that other specimens may, if possible, be secured.

CHAS. D. LIPPINCOTT.

Note on Cassia armata. In the article on "The Genus *Cassia* in North America," which appeared in the BULLETIN for May,* the species *C. armata* S. Watson is characterized as herbaceous. Mr. S. B. Parish, of San Bernardino, Cal., has kindly informed the author that it is in reality a shrub about four feet in height, and adds the following note in regard to its distribution: "It grows in dry, rocky places in the Mojave Desert, but not abundantly. Daggett is the most western known station, and it ranges thence east, hits the adjoining borders of Arizona and Nevada. The San Diego locality quoted by Mr. Pollard is probably a mistake."

The error of calling the plant herbaceous appears in the origi-

* Bull. Torr. Club, 21: 221 (1894).

nal description, and as our eastern material is too scanty to afford any clue to the habits of the species it was naturally repeated in the article in question. C. L. POLLARD.

A Request. I will be greatly indebted to any reader of the BULLETIN who can collect for me several good specimens of any species of *Petalostemon*, especially fruiting ones, and among them at least one with root as near complete as possible. I am engaged in revising the genus, hereafter to be known as *Kuhnistera*, and need good fresh specimens from as many localities as possible. Return will be made in specimens of Texas, Virginia or North Carolina plants. I desire to receive communications on the subject. A. A. HELLER.

411 W. WALNUT STREET, LANCASTER, PA.

Note on the Genus Enslenia Nutt. This generic name, published by Nuttall in 1818 (Gen. 1: 164), is a homonym, it having been used by Rafinesque one year previously (Fl. Ludov. 35) for a different plant. Rafinesque calls attention to this fact in Am. Month. Mag. 4: 192 (1819) and proposes to substitute for it the name *Ampelanus*, but he neither cites species nor gives a description. In order to maintain Rafinesque's very suggestive name, I here designate the species:

AMPELANUS ALBIDUS (Nutt).
Enslenia albida Nutt. Gen. 1: 164.

N. L. BRITTON.

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Atkinson, Geo. F. *Olpitrichum*, a new genus of mucedinous Fungi. Bot. Gaz. 19: 244, 245, *pl. 23*. 20 Je. 1894.

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Davy, J. Burtt. A new species of *Diplacus.* Erythea, **2**: 101, 102. Je. 1894.

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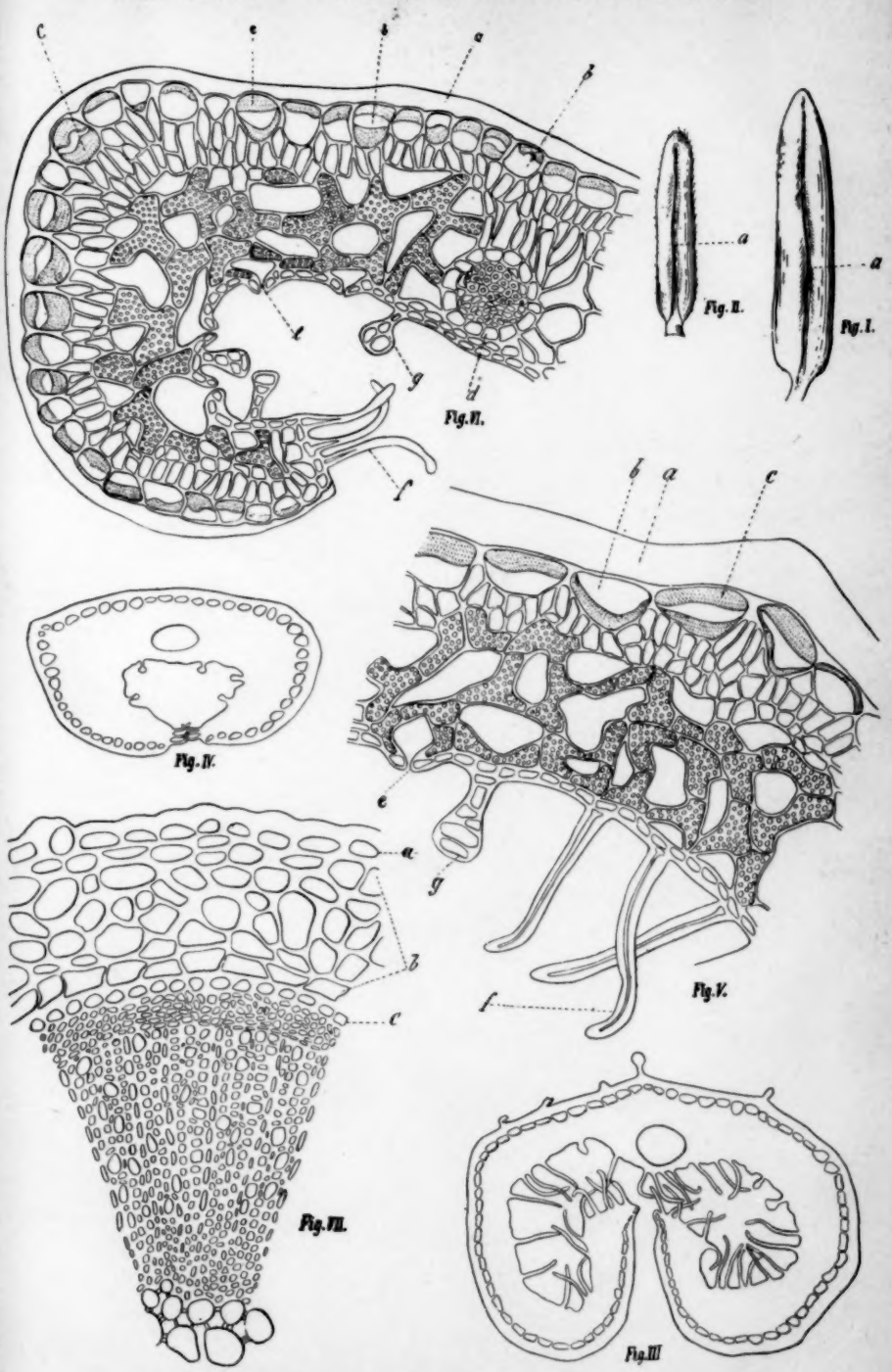

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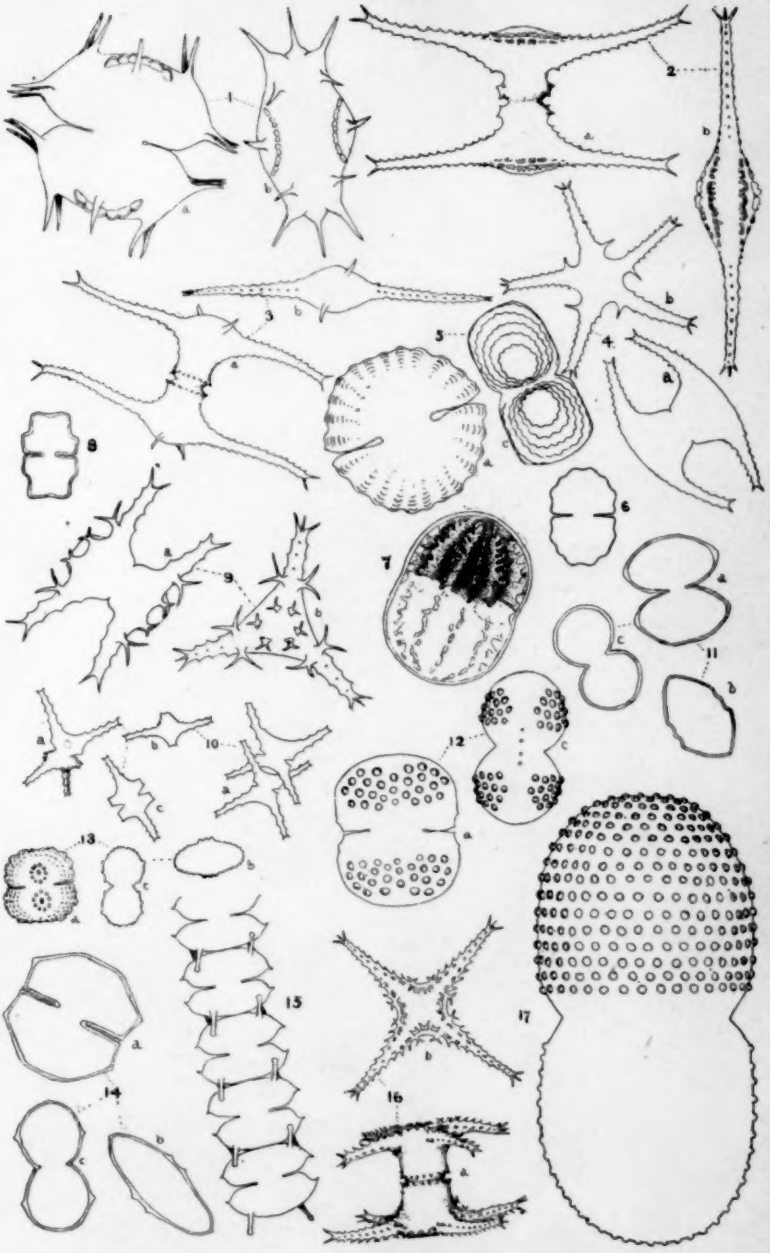

NEW AND RARE DESMIDS.

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Address

MR. T. H. KEARNEY, JR.,

Curator of the Herbarium, Columbia College,

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